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ABSTRACT

Some suggestions are made on how to solve the main difficulties in problems of education and related questions of computer applications. The general outline is as follows: scientific applications for development, scientific background needed, the main difficulties, the present situation, how to start, how to keep highly trained workers in their country (the most serious problem) and a conclusion. (AB)

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Remarks on Some Scientific Applications of Computers for Development

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INTRODUCTION

The general topic is 3.11 of U.N. Report Outline (16 June 1969).

After some short and well known remarks on the various possible Applications of Computers for Development, we want to emphasize where, in our opinion, the main difficulties lie, i.e. (as it is also very well known) in problems of Education and related questions (Section 3.2. below) . We make in Sections 4 and 5 some simple suggestions how one could try to solve these main difficulties in relationship with the particular problems of 3.11., These remarks are not the result of " abstract philosophy " but of facts. The main point is section 6 ; other problems look much less important.

The general outline is as follows :

1. Scientific Applications for Development.
2. Scientific Background needed.
3. The main difficulties.

4. The present situation.

5. How to start.

6. How to keep in their country highly trained workers.

7. Conclusion.

1. SCIENTIFIC APPLICATIONS FOR DEVELOPMENT.

We give only the headlines. This is well known material. The list is obviously not exhaustive !

1.1. ENGINEERING (Generally speaking)

1) Construction of roads, bridges, dams etc...

2) Meteorology.

3) Oceanography. (tides, streams, etc...)

4) Rivers, flooding.

5) Geology.

See also : 1.1, 2).

1.2. MEDICINE.

1) Automatic Interview. Pre-diagnostic.

2) System identification.

3) Operations Research in Hospitals.

1.3. SCHEDULING.

General problems in Mining, Hospitals (1.2, 3)), Economy.

2. SCIENTIFIC BACKGROUND NEEDED.

In order to succesfully implement such applications as mentioned in section , a continuous spectrum of people is needed :

1) Experts on the specific problems with a bit of computer education ;

2) " Computer sciences " people.

We consider only the case of the "Computer Sciences" people.

Here again a continous spectrum of people is needed ; this is well known.

But we want to emphasize one point which is specific of 3.11 :

in order to treat with success anyone of the above mentionned problems, people of high scientific level are needed in the "Computer Sciences" specialty. The reason is that these problems fall in classes where general methods are known, but where the application of the general methods is very seldom a " routine problem ".

3. THE MAIN DIFFICULTIES

3.1. COMPUTER SCIENCES PEOPLE

One must have first a program to train as many people as possible in computer sciences. We return on that point in Section 4 .

The people of high level which are needed for problems of Section 1 (by "high level", we mean : people of the level of the Ph.D , without necessarely working for a Ph.D) are in a small proportion (at most $10/_{100}$) of those trained in Computer Sciences.

3.2. THE DIFFICULTIES

If we admit the possibility to train the high-quality people (and this is not the main problem ; we return on that in Section 5), the

main problem is to keep these workers at home.

Remark 3.1.

Of course one could decide at this point that, after all, these workers can come from more advanced countries.

This is, in our opinion, the worst solution, for two reasons :

(i) political - as it is obvious ! ;

(ii) scientific : only local experts can maintain the necessary continuity and the many human relations absolutely indispensable to implement successfully Engineering or Scheduling programs.

Before giving some suggestions (see Sections 5 and 6) for solving this problem, we want to briefly sum up the present situation in Developing Countries - as far as Scientific Applications of Computers are concerned.

4. THE PRESENT SITUATION

4.1. GENERAL REMARKS

A negative part first : one has to face (and to fight) the very unfortunate tendancy among "second rate" University Circles to consider Computer Sciences (and more generally, applications !) as ranking second behind more "abstract" problems.

It is obvious on the contrary that the training in Developing Countries should be Computer Oriented as much as possible.

An " abstract " teaching in " second rate " places leads to confusion of minds, irrelevant problems and lost of promising young people.

This is obvious - but should be highly emphasized - : it does not seem to be "obvious" in places where it should be... .

We can also remark that a computer oriented teaching can also lead some students to "general" problems.

4.2. NEW TRENDS AMONG YOUNG STUDENTS

Happily, it seems clear to me that, in many places in the world :

(i) young students start to realize what is wrong with 4.1 and wish to make "computer Sciences" studies ;

(ii) many University Professors of Developing Countries are willing to enter in the Computer Field, for helping their students and also on scientific basis for their own work. I know of several Professors in very different places who wish to organize "Summer Schools" in Computer Sciences.

5. HOW TO START

5.1. THE PROBLEM OF THE STUDENTS

Thanks to 4.2, (ii) , I do not think there is a problem with the students : there are many (may be too many!) students willing to start actively working in computer Sciences in all places of the world that I know.

5.2. THE PROBLEM OF THE TEACHING

Here the difficulties come, but they are by no means impossible to solve :

1) It is clear that one can organize Courses by foreign Experts;

2) Simultaneously to 1), "Summer Courses " should be organized for the "fast training" of - in particular - University Professors which are already specialized in other fields and are willing to make an effort in these new directions ; these Professors do exist (see 4.2 (ii));

3) The students abroad their own country ; it is obvious that one could send promising young students in specialized Centers abroad : one has here to be extremely careful to send these students to work in a very precise field of interest to his country : otherwise, back home, he can be scientifically isolated - and leave.

6. HOW TO KEEP HIGHLY TRAINED WORKERS

This is the main problem, in the highly specialized field of Section 3.11 of U N Report Outline.

6.1. GENERAL IDEA

The general idea is to have some international programs on problems of interest to the countries involved and of " distributed " scientific

interest - i.e. where the local application of the program is not a routine problem (without being an advanced research problem).

6.2. EXAMPLES ([1])

We take Section 1.1., examples 1) and 2) (but one can easily make similar problems on most of the other topics mentionned there)

Example 1)

Applications of finite element methods for bridges, dams, "structures" in general.

General methods exist and are well understood.

The application should be made in very close connection with the actual problems.

Variant question : constructions earth-quakes proof.

Example 2)

(1) Application of general methods to local specific problems.

([1]) These remarks can if necessary be made more precise in a Technical Report.

(2) Participation to an international program (at various levels).

Part (1) is much more difficult than in Example 1) - but by no means out of reach ; help by a Foreign expert is likely to be needed at the beginning.

6.3. COST - MATERIAL NEEDED

In the Examples given in Section 6.2, one should emphasize two parts:

a) The cost of such programs is not high - since well organized and highly trained teams already exist in advanced countries.

b) The material needed (ad far as computers are concerned) is standard (no huge computers are needed !)

7. CONCLUSION

This conclusion is related to 3.11 and 3.12 of U.N. Report Outline.

Due to the highly specialized aspects of the Application in 3.11 (except may be Scheduling) one could think of undertake later efforts in these directions.

My opinion is that this is entirely false.

There is no doubt to me that the more sophisticated problems of applications are in 3.11 of U.N. Report Outline (together with some aspects of 3.5, 3.8 and many aspects of 3.9) and these are the only ones who can maintain in their countries the most gifted people.

Due to 6.3 and the preceding remarks, I think that one can - and one should - start as soon as possible programs along the lines of 5.2 and 6.2 , in Engineering fields. Should this effort not be undertaken, there would be the danger (which exists anyway) to having the best people leaving as soon as they could become useful to their country.